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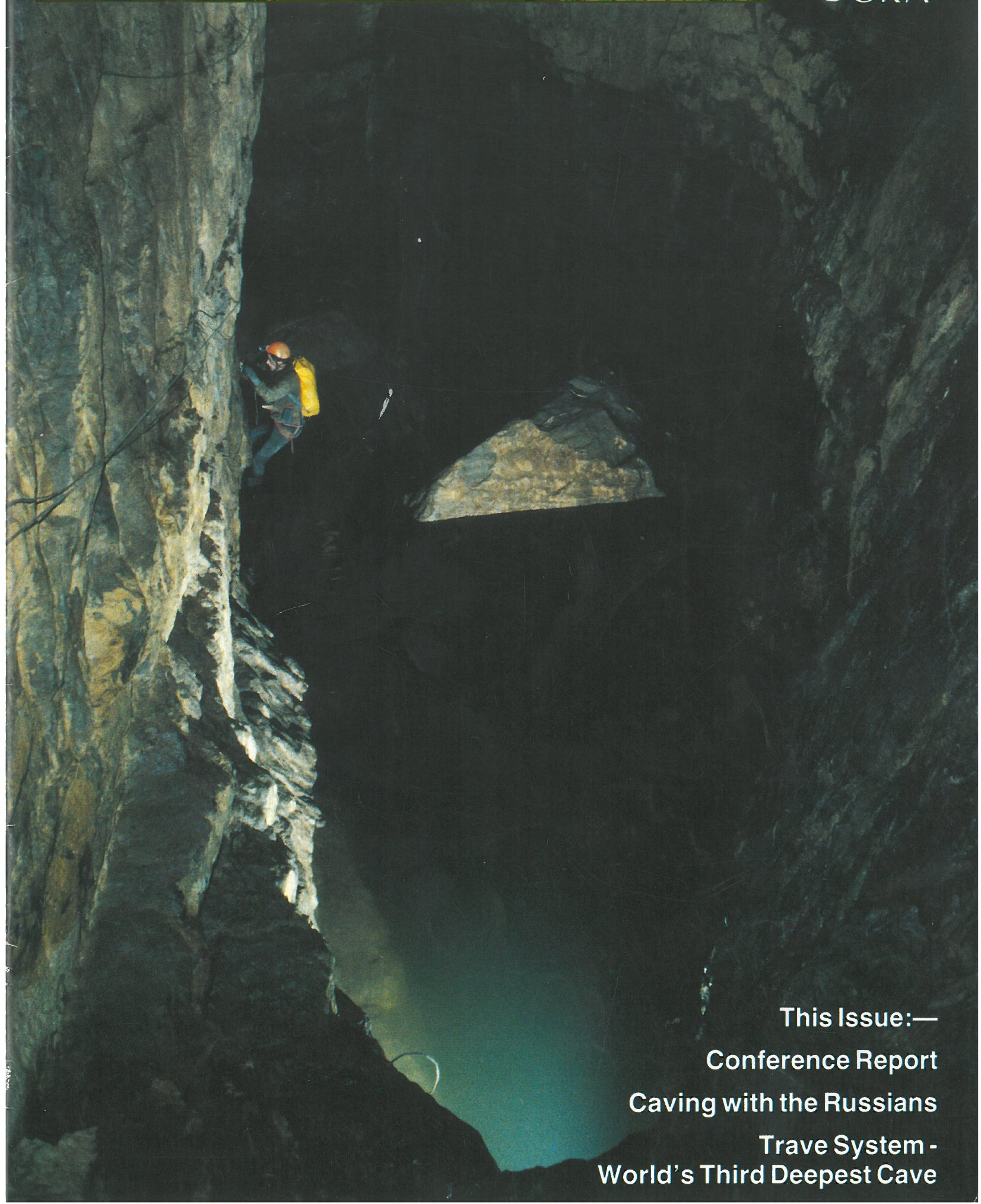


This Issue:—

Conference Report

Caving with the Russians

Trave System - World's Third Deepest Cave

Trave System:
Third deepest cave in the World

Jean Yves-Bigot

British caving groups have done much work in the Picos de Europa Mountains in Northern Spain but even so the deepest cave yet found, the Sistema del Trave in the Central Massif has been explored by a french club. This year after continued exploration by the Speleo Club de la Seine the cave has reached a new record depth of -1441m making it at present the world's third deepest cave.

INTRODUCTION

In the north of the Iberian peninsula, 30km from the sea is the Massif de los Urrieles.(fig No.1) This area contains a large part of the highest karst scenery of the central part of the Picos de Europa.(fig 1) This limestone massif with its rugged relief conceals tectonic structures which have governed the development of the cave system and its hydrology. The links between the geological structure and the morphology of the area can be explained by looking at the formation of the Trave system.

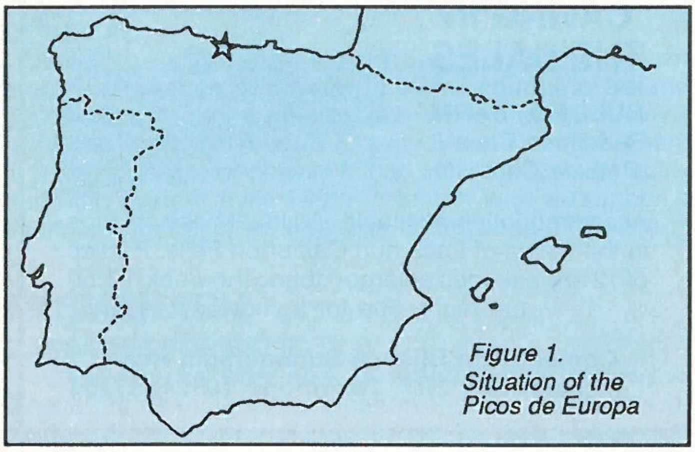


Figure 1. Situation of the Picos de Europa

HISTORY OF EXPLORATION

In the higher parts of the massif the bottoms of large "jous" (shakeholes) are filled with boulders which hide possible access to caves. The rest of the area is made up of isolated and varied karstic forms:- lapiaz, depressions and shafts. It is this area that attracted the Speleo Club de la Seine in 1982. In 1983 the bottom of a massive pitch of 309m was reached. The cave T2 became the main entrance to the Trave system. Exploration ended at the top of a series of pitches at the 800m mark. in 1984 T2 became more important as it reached the -1000m mark. The discovery of another big pitch took it to 1205m.

The bottom of T2 was reached in 1985 at 1250m. Hardly had the ropes been taken out than they were being used again in another cave T10.(Torca de la Laureola) exploration of which ended at about 830m in the middle of a pitch.

In 1986 the bottom was reached at 863m at an impenetrable crack. This disappointment did not last long as we then discovered a small side passage (nouvelle branch) at 330m and new cave T13 (Torca del Alba)levels reached were 490m and 820m respectively.

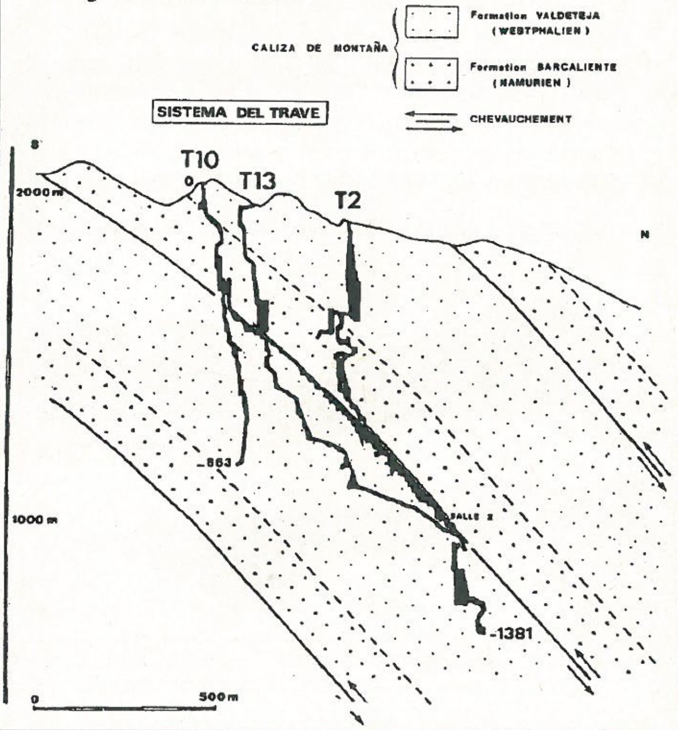
In 1987 the three entrances T1, T13, and T2 were connected and the whole network was christened the SYSTEM DEL TRAVE). It had a total height range of 1381m and the Nouvelle Branch was pushed to -800m. in 1988 more exploration was undertaken in the deeper parts of the system. This new section of exploration was more testing than other parts of the cave. despite some difficulties the 1100m mark was reached. Exploration ended at a pitch. Exploration below here continued in 1989 and its significance is summarised at the end of the article.

GEOLOGICAL STRUCTURE

The stratigraphy of the Picos is made up of massive carbonated layers from the Carboniferous age. In the area of the trave system the stratigraphical column is typical of Barcaliente (Namurian) and Valdetja (Westphalian) formations, which are known collectively as the "Caliza de Montana" (Mountain Limestone). The thrust planes and low angle faults which have developed at the base of the Mountain Limestone layers have allowed the Barcaliente formations to overlap the other rocks in the Trave area, thus building up considerable thickness of limestones (fig No.2).

Figure 2.

Geological Cross-Section.



Under strong lateral pressure from the Hercynian orogenesis the limestone layers have been broken up and intensely folded to form a vast pile of rocks carried along on low angle thrust faults with axes running from north to south. In the Trave area the beds are inclined at 50 degrees NNW.

HYDROLOGY

With almost 2000mm of rain per year on the highest karst areas the Picos have a similar rainfall to that of the Eastern Pyrennees. The proximity of the sea and the high altitude explains the rapid local drainage which is estimated at 55litres/sec/km2. In the Rio Cares the powerful resurgence of the Farfao de la Cares (annual volume 3m3/sec) takes almost half of the water coming out of the Central Massif. Although dye tests have not been done there is every reason to believe that the System del trave is part of Farfao drainage network. (Vidal 1986).

The Trave network has the advantage of showing on a small scale a dendritic network with evidence of underground stream capture (fig 3) Observations made in the cave during the summer season show the scarcity of stream water. The known areas of the system are criss-crossed with streams which all together have a flow rate of only 15litres/sec. A distance of 3.5km and a height difference of 280m separates the end from the presumed resurgence.

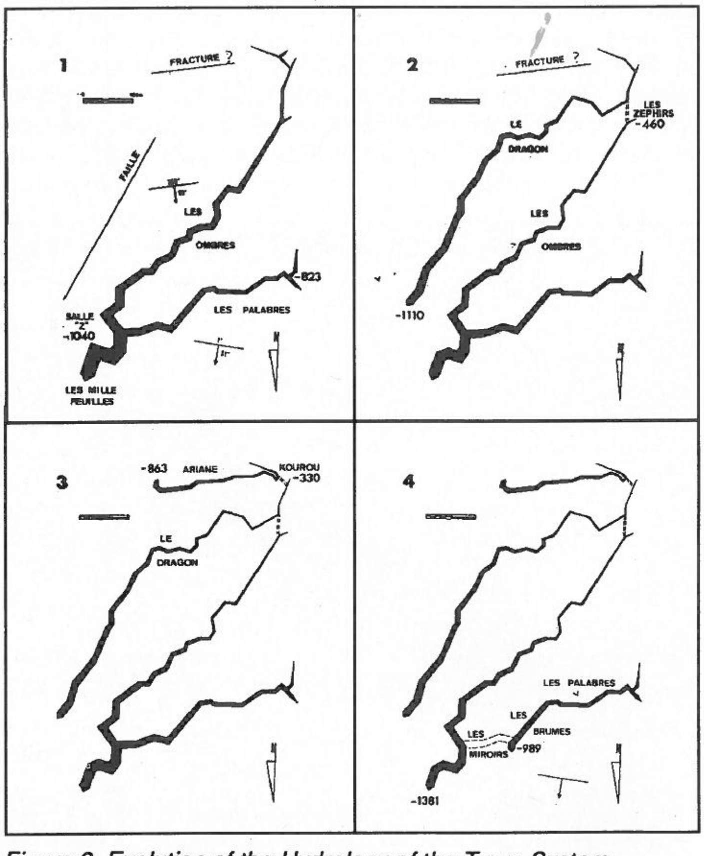


Figure 3. Evolution of the Hydrology of the Trave System.

GLACIO-KARST EVOLUTION

The action of glaciers has greatly influenced the present landscape. The glaciers have originated in the cirques and troughs which form the higher areas of the massif. The cave system is beneath the Jou Lluengu glaciated trough. The area of snow accumulation of the Jou Lluengu glacier stretches from the summit of Torreda Corrida (highest point of the Picos 2648m) down to the 2000m mark where there are shakeholes strung all the way down the mountain side like a string of beads.

From 2000m to 1750m an intermediate zone exists, steeper than the snow accumulation area. It is in this area that the cave system has developed. Lower down where the glacier entered a 600m wide valley its action has been decreased ten fold. This is evident from the roches moutonnees at the bottom of the trough.(fig 4).

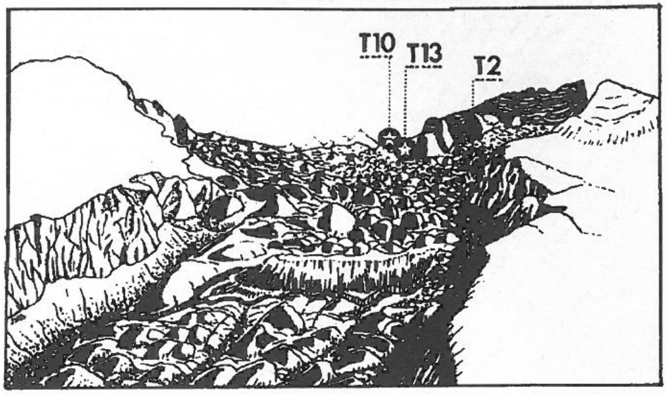


Figure 4. The glaciated valley of Jou Lluengu and the entrances to the System at the base of the Trave Peaks.

There is every reason to believe that almost all the meltwater disappeared below ground before it had chance to form a drainage network on the surface. The streams formed from the subglacial flow have developed a hierarchical network inside the limestone. The seasonal pattern of the meltwater has had the effect of periodically releasing huge amounts of water, which added to the abrasive effects of the materials in suspension, has significantly effected the rate of erosion of the system.

THE HYDROLOGICAL ROLE OF THE THRUST FAULT (Fig 5)

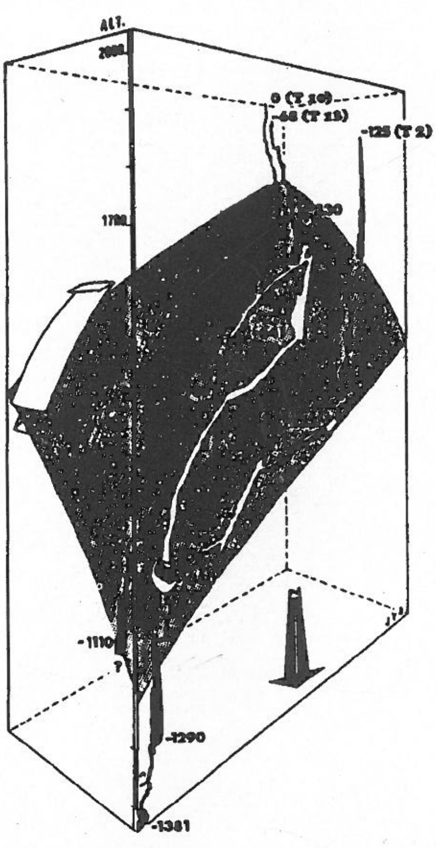


Figure 5. The Trave System and the fault plane seen in perspective.

It has been possible to prove that a thrust fault exists within the area of the Trave system due to two factors:-

a) Observations in the cave -we have concluded from

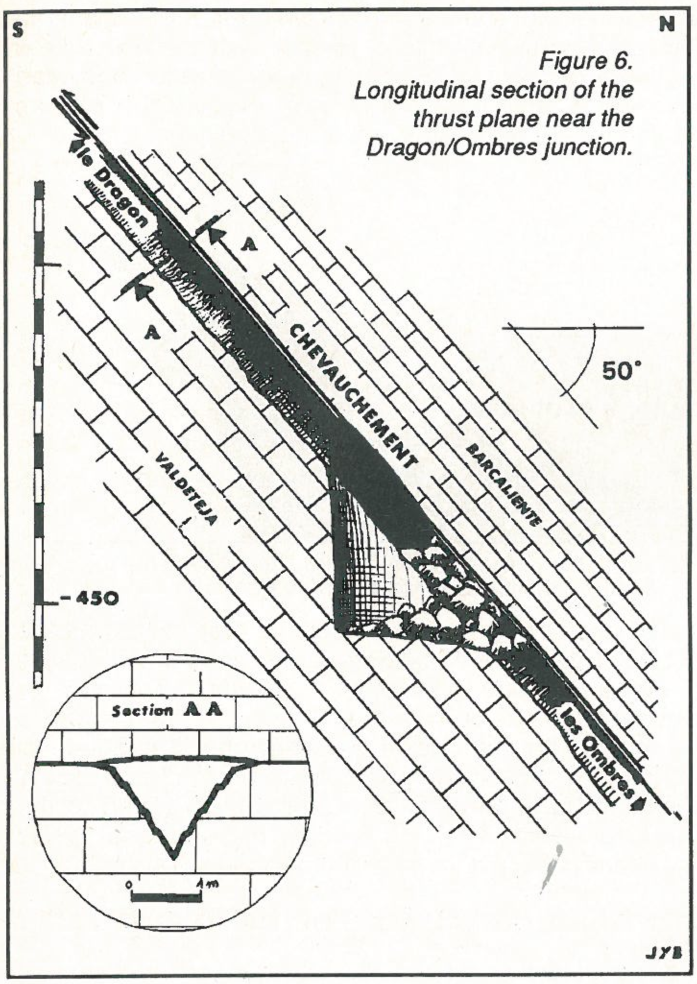


Figure 6. Longitudinal section of the thrust plane near the Dragon/Ombres junction.

underground survey co-ordinates that the inclined planes observed in some places fitted into a much larger context comprising one almost flat surface inclined at 50 degrees.

b) Surface geological observations in the area (Farias 1982). in effect the sloping surface observed underground correspondes to a thrust fault marked on maps a structural cross sections.

The thrust fault represents an optimum line of weakness both on the surface and underground. On the surface differential erosion has taken place along the thrust plane while underground water has eroded the thrust plane to form V-shaped channels, the roofs of which are formed along the fault. The channels develop initially on a small scale sloping down towards the greatest angle of dip of the fault plane and have eventually joined together to form one well marked drainage route, fed by a network of smaller channels. These smaller channels become abandoned as they follow the steep sided meander of the main drainage route. Many of the smaller channels have become fossilised and are impassable except those from the Salle des Zephyrs which have formed the junction between the Dragon and Ombres (fig. 6). However in some parts of the cave the streams do not take the steepest route down the fault plane. For example in the meander of Phalabres and in the fossil meander of Miroir (-1000m) where the way on is along a passage which roughly follows the direction of strike of the plane, unlike the area of the Puits de Brume (from -900 to -1000m) where the passage runs down the thrust fault. (fig 6).

The drainage routes formed down the thrust plane can cut across other hydrological routes formed along other tectonic features, which has resulted in underground stream capture. Such is the case with the Ariane

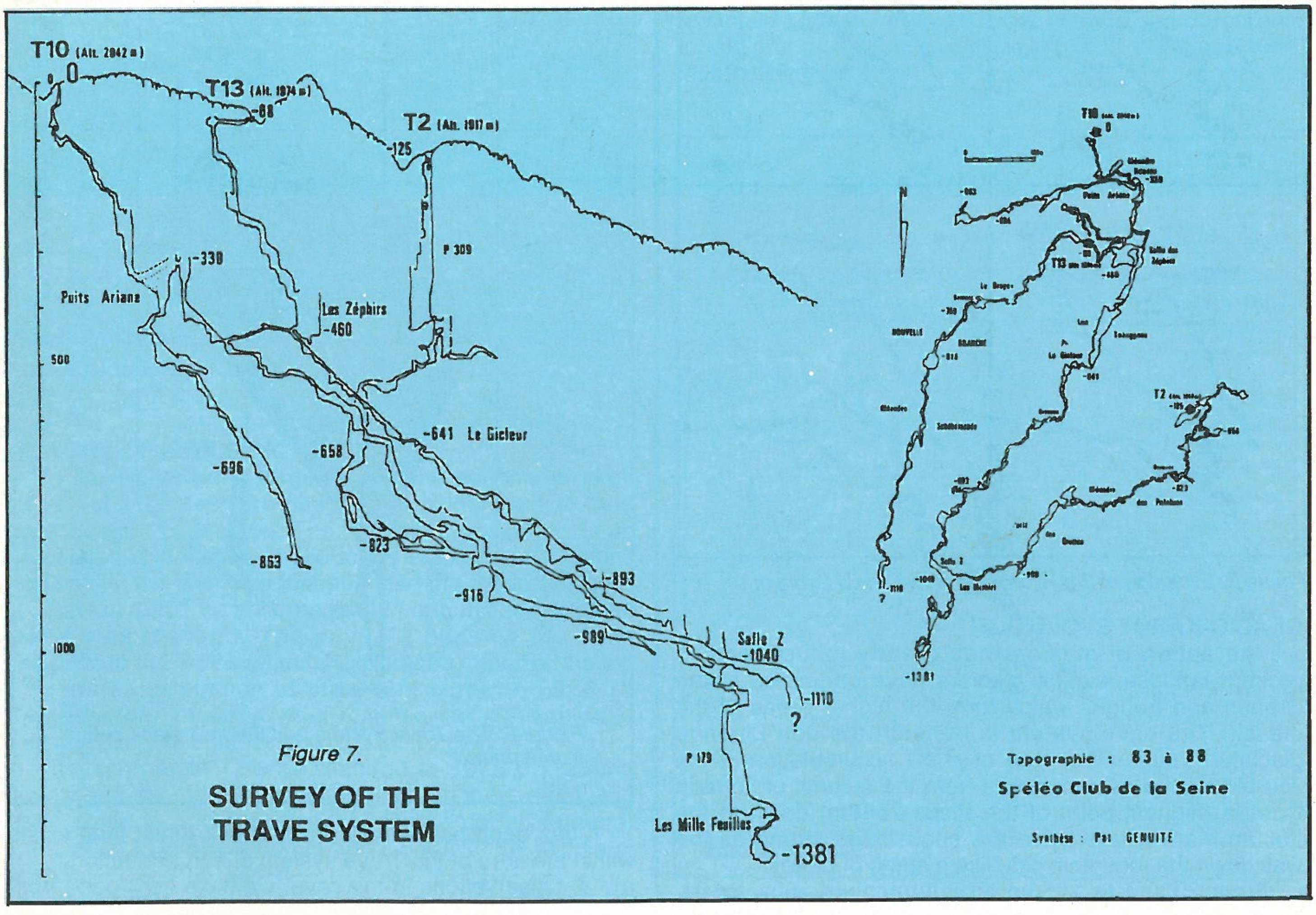
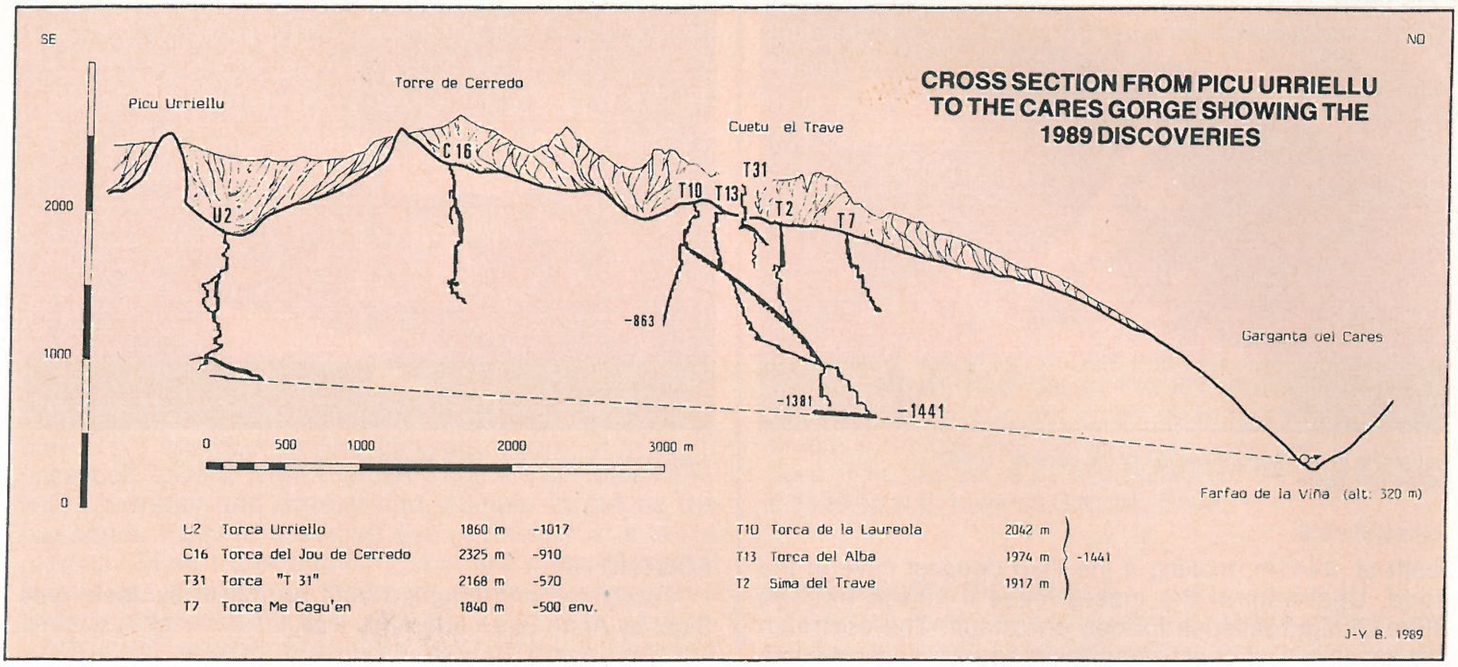


Figure 7.

SURVEY OF THE TRAVE SYSTEM



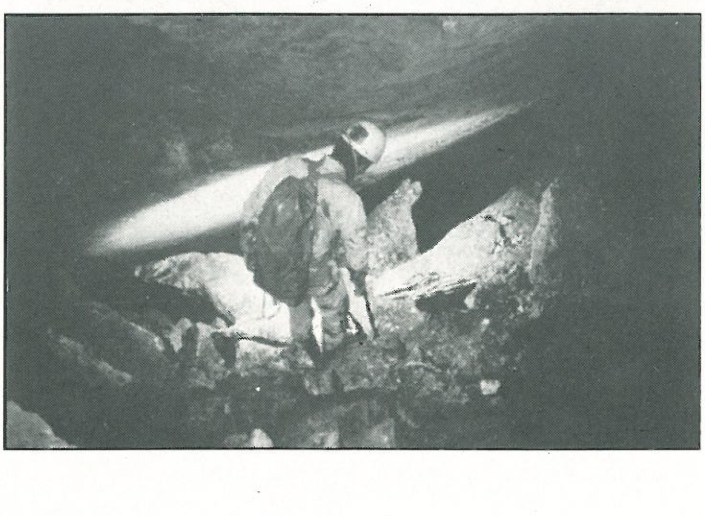
streamway where imposing pitches up to 30m deep have formed due to rejuvination of the stream. In fact originally the upper part of the Ariane streamway fed the Dragon route at about the level of the junction of the two routes at around -330m.

This is not the only example. In the Nouvelle Branch of the system the Dragon streamway follows the route of a north-south trending fault which has allowed the stream to penetrate more than 150m vertically beneath the roof of the thrust fault. Evidence of the vertical fault occurs all the way along between -800m to -1000m.

One other phenomena occurs in the Philabres part of the system at the -989m mark (fig. 3). At this point the stream disappears into the fault. The water sinks in a 20cm high slot and is not seen again. The passage beyond in the Miroirs section of the cave is a dry series of meanders.

Constant rejuvenation must have taken place in the system. The confluence points of many of the streams are now lower down than they were in the past. The progressive uplift of the Picos massif and the inscision of the Rio Cares gorge has produced a relative lowering of the base level. This adds to the effect of the hydrolic gradient has produced a deep cave system with abandoned stream sections and much evidence of stream capture. One cannot dismiss the fact that this process of rejuvenation and the abandonment of various parts of the drainage network could mean that other bits of the system await discovery (fig. 2).

Thrust fault in the roof of Toboggans passage at -550m.
Photos: J.Y. Bogot



BOULDER CHOKES

The development of boulder chokes is relatively rare except in the "pieges a sediment". The most remarkable phenomena is without doubt the "Salle des Milles-feuilles" at the -1330m mark (see photo). Here huge deposits of sediment have been penetrated by a trickle of water which runs through it making it possible to see through the sediment layers for a total height of 50m. The sediments are composed of layers of yellow banded mud intersperced with coarser sediments resembling concrete. It is thought that the presence of so many successive sedimentary phases could well correspond to deposits of glacial varve like deposits trapped at a pivot point between the vertical and horizontal transit of the meltwater. The bottom of the chamber is filled with a choke of cemented and rounded pebbles which have fallen in blocks from the cobbled sedimentary bed which forms the roof.

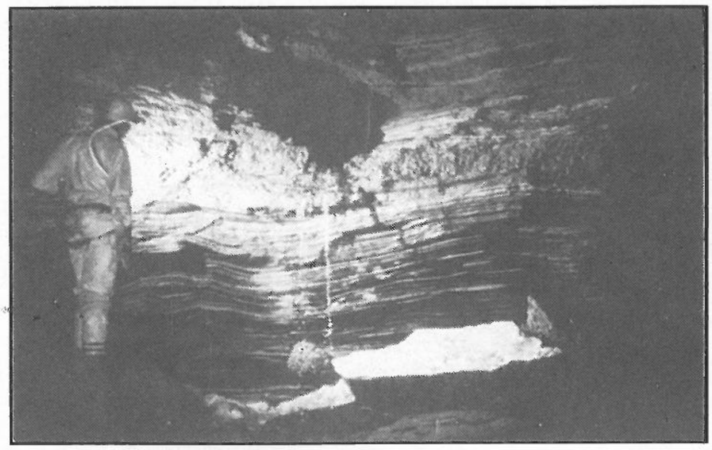
CONCLUSION & 1989 EXPLORATIONS

The exploration of the System del Trave will continue for some years to come and its exploration has allowed the Speleo Club de la Seine to unravel some of the secrets of deep caves of this part of the Picos (fig 7).

In 1988 exploration of the Nouvelle Branch of the system ended at the -1110m mark at the top of an undescended big pitch below Salle Z. The main aim of this year's expedition was to explore beyond this point in the hope of finding a route through to the hydrological system which feeds the powerful resurgence at Farfao de la Vina in the Cares Gorge. In August the dream became a reality when after exploring down over 300m of pitches below the 1100m mark a main drain was reached carrying 150litres of water per second. The flow observed at a time of extremely low flow conditions corresponded to half that of the water coming from the resurgence at Farfao.

The dream of following the cave through to the resurgence was short lived as not far downstream the river disappeared into a magnificent sump 4m wide, at a record

Traversing in the "Miriors section of the cave at -1000m. Photo: J.Y. Bigot



Sediment banks in the "Mille Feuilles" chamber. Photo: B. Vidal

depth of -1441m. making it the third deepest cave in the world. Upstream in the master cave it flowed through 400m of high galleries formed on a fault. The upstream end is composed of an impassable boulder choked sump (fig 8).

Continued exploration was then diverted to the bottom end of T2 at the -1280m mark where a draughting passage was left for another year. The tremendous draught which fills the last sections of the meanders and the black wind eroded mud formations which plaster the walls are reminders to the explorer that the heart of these caves floods dramatically. This news must reawaken the enthusiasm of those sceptics who doubted the existance of any negotiable or abandoned streamway at the bottom of the system.

During the course of the expedition T31 was pushed to -570m however hopes of linking it to the main system remain slim.

FOOTNOTE

Translated and adapted from an article by Jean-Yves Bigot by Anne Black and Andy Hall.

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